REMARKS/ARGUMENTS

Claims 1 – 12, 14 – 15, and 17 - 18 are in the application. Reconsideration is respectfully requested.

Objection to the Declaration

Applicant notes that the present application was filed with an Application Data Sheet that identifies on page 3 thereof the foreign application for patent upon which priority is claimed. The inclusion of this information in the Application Data Sheet obviates the need for the same in the Declaration (37 CFR 1.63(c)) and, therefore, applicant believes that this objection may be withdrawn.

Drawings

Applicant filed on August 29, 2005 replacement sheets of drawings (9 total) amended to include reference numbers. Applicant respectfully requests the Examiner's approval of the amended drawings.

Specification

By this amendment, the omitted application number has been provided on page 18, line 20. For the Examiner's information, this number matches the application number provided on page 4, second paragraph, of the application.

Several other paragraphs in the specification have been amended in this paper to provide reference numerals that correspond to the drawing amendments made in the drawings-replacement paper filed August 29, 2005.

Claim Objections

Claim 3 has been amended to include the phrase "Direction of Arrival," to serve as antecedent basis for the acronym DOA used thereafter in the claims. "Direction of Arrival" is well known in the art and defined on page 2 of the present application. This amendment obviates this objection. Claim 6 is similarly amended here.

Claim Rejections 35 USC 112, Second Paragraph

Claim 1 has been amended to address the indefinite rejection pointed out be the Examiner.

Claim Rejections 35 USC 102

Claims 1 and 7 have been rejected as anticipated by the disclosure of Youssefmir et al, US Patent Number 6,141, 567. For the following reasons, applicant respectfully traverses this rejection.

The Examiner's attention is drawn, firstly, to the Summary of Invention of the present application (page 5) in which it is stated:

"it is a primary object of this invention to seek to provide a practical, inexpensive and efficient method for realising downlink beamforming. In particular, it is an object of the invention to seek to provide a method of generating downlink beamforming weights using uplink beamforming weights, which comprise information already available at the base station"

In addition, the Examiner's attention is drawn to the final section of page 6 of the application as filed, which states:

"The basic properties and benefits of the present invention are summarised as follows:

1. The main concern complicating FDD systems is the lack of downlink channel vector estimates. The present invention does not require downlink channel responses for generating downlink beamforming weights.

2. The present invention is simple for implementation as it does not require complicated computations nor large space for data storage."

In short, the present invention provides a method of obtaining downlink beamforming weights from uplink beamforming weights, without the need for downlink channel responses (which decrease the efficiency of the communications system) and without the need for large data storage space or complex calculations.

In contrast with these statements concerning the present invention, Youssefmir et al states in column 3, lines 26 to 30:

"the invention being used to modify the smart antenna uplink or downlink processing strategy, for example, the receive or transmit or weights, applied to signals received or transmitted by a plurality of antenna elements"

and in the same column, lines 35 to 40:

"When processing received signals, an aspect of the invention modifies an existing processing scheme by incorporating information about a second set of signals for which

training or other characteristic information is unknown to information about a first set of signals for which such characteristic information is known, prior to executing the processing scheme"

Therefore, the system disclosed in Youssefmir et al merely modifies an existing downlink beamforming scheme and, as indicated in the second of the extracted passages above, this is carried out by utilizing a first and second set of signals. Importantly, characteristic information is known about the first set of signals. This is in agreement with the prior art, as set out in the present application, as it is clear (see column 15, lines 32 to 36) that this information would include downlink channel responses and similar known characteristic information. The approaches suggested by Youssefmir et al in columns 6 and 7 for estimating uplink beamforming weights substantially match the discussion of the prior art as set out in the background discussion of the present application or are not appropriate for a frequency-division-duplex system.

Furthermore, in one embodiment of the method disclosed in Youssefmir et al, information about a large number of signal bursts is needed and this requires a large amount of data storage space - see the bottom of column 17 of Youssefmir et al. Some of the signal bursts contain interferer signals, some contain user signals, some contain neither and some contain both. This information is then used to add nulls corresponding to the direction of arrival (DOA) of the interferers. This large amount of storage space is not required by the present invention as pointed out above.

Another important difference between Youssefmir and the present invention is that Youssefmir either uses downlink response information to determine the downlink weights or it uses a computationally basic method which calculates the downlink weights directly from the uplink weights with some calibration to overcome differences between the transmitter and receiver electronic signal paths (see the first paragraph of column 13) – both methods are described in the prior art discussion of the present invention. Neither of these two methods involve determining the *uplink nulls* and main beam position from the uplink weights and using this information to form *downlink nulls* and then downlink weights *from all the downlink nulls*.

Youssefmir concentrates on forming the downlink weights then studying the position of the downlink main beam and nulls, and adjusting the position of the nulls to match the positions of interferers. In contrast, the present invention provides a computationally simple method of determining the downlink weights (which does not require downlink channel responses but uses

the uplink nulls to form downlink nulls and the downlink nulls to form downlink weights) but which is more accurate than the very basic method of using the calibrated uplink weights as downlink weights.

Therefore, the present invention is not anticipated by the disclosure of Youssefmir et al, fundamentally because claim 1 of the present application requires a method for downlink beamforming in which the first two steps are:

receiving at said base station antenna array combinations of arriving uplink signals from said plurality of remote terminals,

and

estimating an uplink beamforming weight vector for each of said terminals from said combinations of arriving uplink signals.

Similarly, claim 7 recites:

receiving at said base station antenna array combinations of arriving signals from said plurality of remote terminal ...

generating a downlink beamforming weight based on the signal's uplink beamforming weight

Since, these steps are not disclosed or contemplated by the method of Youssefmir et al, which requires the uplink or downlink beamforming weights to have already been produced by using downlink channel responses rather than combinations of uplink signals, the invention defined in claims 1 and 7 is patentable over Youssefmir et al.

The just identified distinction applies equally to third, fourth, and fifth steps of the method of claim 1, since the purpose of the method of Youssefmir et al is to add nulls corresponding to the direction of arrival of signals from interferers. Therefore, there are no steps disclosed in Youssefmir which are directly comparable to *identifying uplink nulls and an uplink main beam position from said uplink beamforming weight vector; transforming each of said uplink nulls to form a corresponding downlink null;* and *generating a downlink beamforming weight vector from all downlink nulls.* Instead, additional nulls are added to a beamforming weight which has already been determined by an alternative method (previously mentioned).

Moreover, the disclosure of Youssefmir et al, alone or in combination, cannot be said to render obvious the subject matter of Claims1 or 7.

In particular, the present invention provides a method for downlink beamforming in a frequency-division-duplex wireless communication system which does not require downlink channel responses for generating downlink beamforming weights and does not require complicated computations or large data storage space. Youssefmir et al discloses a method of modifying a conventional downlink beamforming weight generation method by utilizing information concerning, for example, old signals previously received from the user. The method requires characteristic information (such as downlink channel responses) concerning the uplink signals before the downlink beamforming weights can be generated. This teaching leads the skilled reader directly away from the solution offered by the present invention.

Furthermore, there is no indication or teaching in any of the prior art documents that the steps (described above) which allow the present invention to operate in such an advantageous manner, should be utilized.

Claim Rejections 35 USC 103(a)

Claim 11 was rejected as being unpatentable over Youssefmir in view of Dent, US Patent No. 5,619,503, and further in view of Bakrhu, US Patent No. 4,173,759.

The Examiner points out that Youssefmir does not disclose the steps of dividing a communication cell into a plurality of sectors and identifying uplink nulls which would yield pseudo nulls in a sector. Applicant respectfully traverses the Examiner subsequent assertion that a skilled person upon reading Dent would understand that splitting a cell into a plurality of sectors would be obvious.

The section of Dent which the Examiner has identified (Col. 1, line 58 to Col. 2, line 10) is specifically *not* the splitting of a cell into a plurality of sectors. Instead, it is the transmission to three separate cells from a common site at the junction of three cells which is disclosed. For example, it is stated in column 2 of Dent that:

"The 3-sector, 7-site method of illumination is sometimes called sectorization, which can give the erroneous impression that an originally larger cell was split into three smaller cells or sectors by use of directional antennas. This impression, however, is inaccurate because the arrangement used for illuminating three cells from the same site is merely an economic arrangement that actually has slight disadvantages over central illumination with respect to technical performance but is otherwise very similar."

Dent does, however, state that it would be desirable to allow a cell to be split into sectors with the same frequencies being used in each without the obvious interference problem, but fails to teach how such a method would be possible, concentrating instead upon using signal strength matrices to remove interference.

Therefore, a skilled person would have no motivation to combine the disclosure of Dent with that of Youssefmir since there is not disclosed or suggested motivation to do so.

Furthermore, even if a skilled person were to combine the teachings of Youssefmir with those of Dent, the step of constraining the use of the system to those terminals in a sector in which no pseudo nulls will be generated is not disclosed.

The Examiner suggests that this feature may be found in Bakhru but this document teaches the skilled person to steer the main beam and therefore the nulls (notably not pseudo nulls created by the null wrapping phenomenon) such that the main beam follows the terminal. This is not the same as constraining the use of the system to those terminals in a sector in which no pseudo nulls will be generated, not least because no sectorization is taught by Bakhru and no pseudo nulls would be created by the system disclosed in Bakhru. Furthermore, this disclosure is nothing more than a basic downlink weight forming system which uses simple steering vectors to adjust the downlink weights so that the main beam follows the desired user (or terminal).

In short, a proper *prima facie* case of obviousness cannot be made from the art of record. Therefore, the present invention as defined in Claim 11 is believed to be patentable.

Claims 12 and 15 were rejected as being unpatentable over Youssefmir in view of Boros, US Patent No. 6,615,024.

The penultimate clause of Claim 12 has been amended here to provide proper antecedent basis for the term "downlink nulls."

Moreover, claim 12 has been amended to particularly point out certain features of the downlink weight generator (essentially, identifying uplink nulls in a signal, transforming identified uplink nulls to form a downlink null, and generating the downlink beamforming weight vector from the downlink nulls) that, for the reasons set forth above in connection with claims 1 and 7, are not disclosed or contemplated in the art of record. Accordingly, claim 12 is believed to be allowable.

Claims 13 and 16 were rejected as being unpatentable over Youssefmir in view of Boros, and further in view of Bryanos, US Patent No. 5,349,364. Claim 16 has been cancelled, and claim

18 is substituted here for now-cancelled claim 13. Claim 18 is directed to the key concept of former claim 13; namely, a method of antenna spacing to alleviate null wrapping. Support for new claim 18 appears in pages 22 and 23 of the present application. The particular step of "*determining the antennae spacing range ...*" of claim 18 is neither disclosed nor suggested in Bryanos and, therefore, the method of claim 18 is patentable over the combination of teachings suggested by the Examiner.

Claims 14 and 17 were rejected as being unpatentable over Youssefmir in view of Boros, and further in view of Dent.

In response, applicant notes that the argumentation presented above in relation to claim 11 and Dent is equally applicable for this claim 14. Furthermore, there is no teaching in any of the prior art document to identify uplink nulls which would yield pseudo nulls in a sector. This is because none of the prior art documents uses the form of sectorization required by claim 14, or the particularly effective method of the present invention which determines the downlink weights by utilizing uplink null and main beam positions.

Conclusion

In view of the foregoing, applicant believes that all of the currently pending claims are in condition for allowance, and an early notification to that effect is respectfully requested. If the Examiner has any questions, he is invited to contact applicant's attorney at the below-listed telephone number.

Respectfully submitted,
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